

**CPC****COOPERATIVE PATENT CLASSIFICATION****F02G**

**HOT GAS OR COMBUSTION-PRODUCT POSITIVE-DISPLACEMENT ENGINE PLANTS** (steam engine plants, special vapour plants, plants operating on either hot gas or combustion-product gases together with other fluid [F01K](#); gas-turbine plants [F02C](#); jet-propulsion plants [F02K](#)); **USE OF WASTE HEAT OF COMBUSTION ENGINES; NOT OTHERWISE PROVIDED FOR**

**NOTE**

Attention is drawn to the notes preceding class [F01](#).

**F02G 1/00**

**Hot gas positive-displacement engine plants** (positive-displacement engine plants characterised by the working gas being generated by combustion in the plant [F02G 3/00](#))

[F02G 1/02](#)

- . of open-cycle type

[F02G 1/04](#)

- . of closed-cycle type

[F02G 1/043](#)

- .. the engine being operated by expansion and contraction of a mass of working gas which is heated and cooled in one of a plurality of constantly communicating expansible chambers, e.g. Stirling cycle type engine

[F02G 1/0435](#)

- ... {the engine being of the free piston type}

[F02G 1/044](#)

- ... having at least two working members, e.g. pistons, delivering power output

[F02G 1/0445](#)

- .... {Engine plants with combined cycles, e.g. Vuilleumier}

[F02G 1/045](#)

- ... Controlling

[F02G 1/047](#)

- .... by varying the heating or cooling

[F02G 1/05](#)

- .... by varying the rate of flow or quantity of the working gas

[F02G 1/053](#)

- ... Component parts or details

[F02G 1/0535](#)

- .... {Seals or sealing arrangements}

[F02G 1/055](#)

- .... Heaters or coolers

[F02G 1/057](#)

- .... Regenerators

[F02G 1/06](#)

- . Controlling

**F02G 3/00**

**Positive-displacement engine plants characterised by the working gas being generated by combustion in the plant**

[F02G 3/02](#)

- . with reciprocating-piston engines

**F02G 5/00**

**Profiting from waste heat of combustion engines, not otherwise provided for**

[F02G 5/02](#)

- . Profiting from waste heat of exhaust gases

[F02G 5/04](#)

- .. in combination with other waste heat from combustion engines

**F02G 2242/00****Ericsson-type engines having open regenerative cycles controlled by valves**

- F02G 2242/02 . Displacer-type engines
- F02G 2242/04 . . having constant working volume
- F02G 2242/06 . . . with external drive displacers
- F02G 2242/08 . . . . having gas actuated valves, e.g. "Bush engines"
- F02G 2242/10 . . . . having mechanically actuated valves, e.g. "Gifford" or "McMahon engines"
- F02G 2242/30 . . having variable working volume
- F02G 2242/32 . . . Regenerative displacers with independent pistons
- F02G 2242/40 . Piston-type engines
- F02G 2242/42 . . having a single piston regenerative displacer attached to the piston, e.g. "Gifford-McMahon" engines
- F02G 2242/44 . . having two pistons and reverse flow regenerators

**F02G 2243/00****Stirling type engines having closed regenerative thermodynamic cycles with flow controlled by volume changes**

- F02G 2243/02 . having pistons and displacers in the same cylinder
- F02G 2243/04 . . Crank-connecting-rod drives
- F02G 2243/06 . . . Regenerative displacers
- F02G 2243/08 . . . External regenerators, e.g. "Rankine Napier" engines
- F02G 2243/20 . . each having a single free piston, e.g. "Beale engines"
- F02G 2243/202 . . . resonant
- F02G 2243/204 . . . non-resonant
- F02G 2243/206 . . . externally excited
- F02G 2243/22 . . with oscillating cylinders
- F02G 2243/24 . . with free displacers
- F02G 2243/30 . having their pistons and displacers each in separate cylinders (**two-piston machines R02G 44/00**)
- F02G 2243/32 . . Regenerative displacers having parallel cylinder, e.g. "Lauberau" or "Schwartzkopff" engines
- F02G 2243/34 . . Regenerative displacers having their cylinders at right angle, e.g. "Robinson" engines
- F02G 2243/36 . . with twin-expansion cylinders, e.g. "Rainbow" engines
- F02G 2243/38 . . External regenerators having parallel cylinders, e.g. "Heinrici" engines
- F02G 2243/40 . . with free displacers
- F02G 2243/50 . . having resonance tubes
- F02G 2243/52 . . . acoustic
- F02G 2243/54 . . . thermo-acoustic

**F02G 2244/00****Machines having two pistons**

- F02G 2244/02 . Single-acting two piston engines
- F02G 2244/04 . . of rotary cylinder type, e.g. "Finkelstein" engines
- F02G 2244/06 . . of stationary cylinder type
- F02G 2244/08 . . . having parallel cylinder, e.g. "Rider" engines
- F02G 2244/10 . . . having cylinders in V-arrangement
- F02G 2244/12 . . . having opposed pistons
  
- F02G 2244/50 . Double acting piston machines
- F02G 2244/52 . . having interconnecting adjacent cylinders constituting a single system, e.g. "Rinia" engines
- F02G 2244/54 . . having two-cylinder twin systems, with compression in one cylinder and expansion in the other cylinder for each of the twin systems, e.g. "Finkelstein" engines

**F02G 2250/00****Special cycles or special engines**

- F02G 2250/03 . Brayton cycles
- F02G 2250/06 . Beau de Rochas constant volume cycles
- F02G 2250/09 . Carnot cycles in general
- F02G 2250/12 . Malone liquid thermal cycles
- F02G 2250/15 . Sabathe mixed air cycles
- F02G 2250/18 . Vuilleumier cycles
- F02G 2250/21 . Cooke Yarborough engines
- F02G 2250/24 . Ringbom engines, the displacement of the free displacer being obtained by expansion of the heated gas and the weight of the piston
- F02G 2250/27 . Martini Stirling engines
- F02G 2250/31 . Nano or micro engines

**F02G 2253/00****Seals**

- F02G 2253/01 . Rotary piston seals
- F02G 2253/02 . Reciprocating piston seals

- F02G 2253/03 . Stem seals
- F02G 2253/04 . Displacer seals
- F02G 2253/06 . Bellow seals
- F02G 2253/08 . Stem with rolling membranes
- F02G 2253/10 . Piston with rolling membranes
- F02G 2253/50 . Liquid seals
- F02G 2253/60 . Sealing of the lubrication circuit
- F02G 2253/80 . Sealing of the crankcase

#### **F02G 2254/00      Heat inputs**

- F02G 2254/05 . by air
- F02G 2254/10 . by burners
- F02G 2254/11 . . Catalytic burners
- F02G 2254/12 . by ejectors
- F02G 2254/15 . by exhaust gas
- F02G 2254/18 . using deflectors, e.g. spirals
- F02G 2254/20 . using heat transfer tubes
- F02G 2254/30 . using solar radiation
- F02G 2254/40 . using heat accumulators
- F02G 2254/45 . by electric heating
- F02G 2254/50 . Dome arrangements for heat input
- F02G 2254/60 . using air preheaters
- F02G 2254/70 . by catalytic conversion, i.e. flameless oxydation
- F02G 2254/90 . by radioactivity

**F02G 2255/00****Heater tubes**

F02G 2255/10

- . dome shaped

F02G 2255/20

- . Heater fins

**F02G 2256/00****Coolers**

F02G 2256/02

- . Cooler fins

F02G 2256/04

- . Cooler tubes

F02G 2256/50

- . with coolant circulation

**F02G 2257/00****Regenerators**

F02G 2257/02

- . rotating

**F02G 2258/00****Materials used**

F02G 2258/10

- . ceramic

F02G 2258/20

- . having heat insulating properties

F02G 2258/50

- . having frictional properties

F02G 2258/80

- . having magnetic properties

F02G 2258/90

- . Processing of materials

**F02G 2260/00****Recuperating heat from exhaust gases of combustion engines and heat from cooling circuits****F02G 2262/00****Recuperating heat from exhaust gases of combustion engines and heat from lubrication circuits**

**F02G 2270/00****Constructional features**

- F02G 2270/005 . Shells, e.g. a sealed or sealing shell for a Stirling engine
- F02G 2270/02 . Pistons for reciprocating and rotating
- F02G 2270/04 . Roller assemblies connecting opposed pistons
- F02G 2270/10 . Rotary pistons
- F02G 2270/15 . Rotating cylinders
- F02G 2270/20 . Plural piston swash plates
- F02G 2270/30 . Displacer assemblies
- F02G 2270/40 . Piston assemblies
- F02G 2270/42 . Displacer drives
- F02G 2270/425 . . the displacer being driven by a four-bar mechanism, e.g. a rhombic mechanism
- F02G 2270/45 . Piston rods
- F02G 2270/50 . Crosshead guiding pistons
- F02G 2270/55 . Cylinders
- F02G 2270/60 . Counterweights for pistons
- F02G 2270/70 . Liquid pistons
- F02G 2270/80 . Engines without crankshafts
- F02G 2270/85 . Crankshafts
- F02G 2270/90 . Valves
- F02G 2270/95 . Pressurised crankcases

**F02G 2275/00****Controls**

- F02G 2275/10 . for vibration reduction
- F02G 2275/20 . for preventing piston over stroke
- F02G 2275/30 . for proper burning

F02G 2275/40 . for starting

**F02G 2280/00      Output delivery**

F02G 2280/005 . Medical applications, e.g. for prosthesis or artificial hearts

F02G 2280/10 . Linear generators

F02G 2280/20 . Rotary generators

F02G 2280/50 . Compressors or pumps

F02G 2280/60 . Heat pumps

F02G 2280/70 . Clutches

**F02G 2290/00      Engines characterised by the use of a particular power transfer medium, e.g. Helium**